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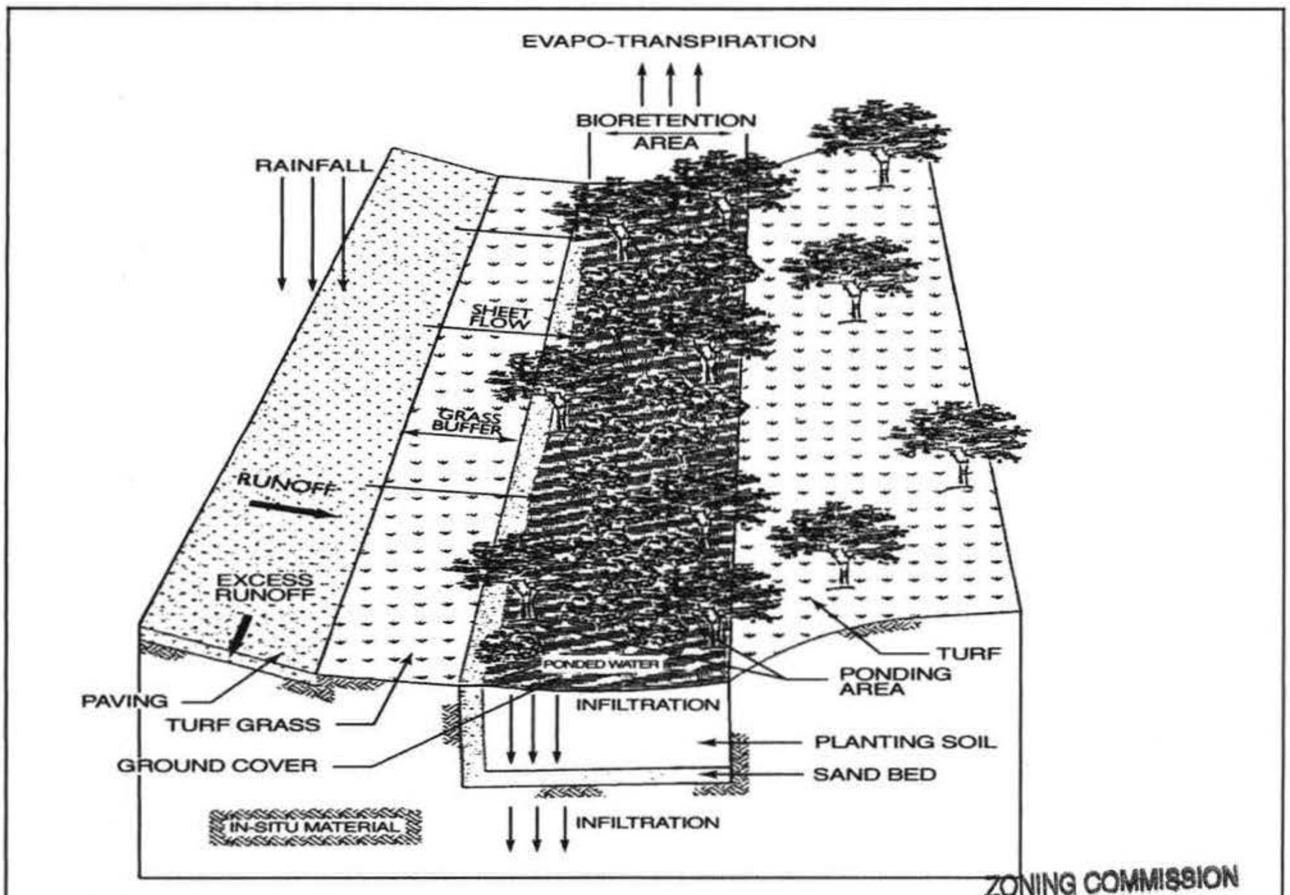
EPA

Storm Water Technology Fact Sheet
Bioretention

DESCRIPTION

Bioretention is a best management practice (BMP) developed in the early 1990's by the Prince George's County, MD, Department of Environmental Resources (PGDER). Bioretention utilizes soils and both woody and herbaceous plants to remove pollutants from storm water runoff. As shown in Figure 1, runoff is conveyed as sheet flow to the treatment area, which consists of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. Runoff passes first over or through a sand bed, which slows the runoff's velocity, distributes it evenly along the length of the ponding area, which consists of a surface organic layer and/or ground cover and the underlying planting soil. The ponding area is graded, its center depressed. Water is ponded to a depth of 15 centimeters (6 inches) and gradually infiltrates the bioretention area or is



Source: PGDER, 1993.

FIGURE 1 BIORETENTION AREA

evapotranspired. The bioretention area is graded to divert excess runoff away from itself. Stored water in the bioretention area planting soil exfiltrates over a period of days into the underlying soils.

The basic bioretention design shown in Figure 1 can be modified to accommodate more specific needs. The City of Alexandria, VA, has modified the bioretention BMP design to include an underdrain within the sand bed to collect the infiltrated water and discharge it to a downstream sewer system. This modification was required because impervious subsoils and marine clays prevented complete infiltration in the soil system. This modified design makes the bioretention area act more as a filter that discharges treated water than as an infiltration device. Design modifications are also being reviewed that will potentially include both aerobic and anaerobic zones in the treatment area. The anaerobic zone will promote denitrification.

APPLICABILITY

Bioretention typically treats storm water that has run over impervious surfaces at commercial, residential, and industrial areas. For example, bioretention is an ideal storm water management BMP for median strips, parking lot islands, and swales. These areas can be designed or modified so that runoff is either diverted directly into the bioretention area or conveyed into the bioretention area by a curb and gutter collection system. Bioretention is usually best used upland from inlets that receive sheet flow from graded areas and at areas that will be excavated. The site must be graded in a manner that minimizes erosive conditions as sheet flow is conveyed to the treatment area, maximizing treatment effectiveness. Construction of bioretention areas is best suited to sites where grading or excavation will occur in any case so that the bioretention area can be readily incorporated into the site plan without further environmental damage. Bioretention should be used in stabilized drainage areas to minimize sediment loading in the treatment area. As with all BMPs, a maintenance plan must be developed.

Bioretention has been used as a storm water BMP since 1992. In addition to Prince George's County and Alexandria, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

ADVANTAGES AND DISADVANTAGES

Bioretention is not an appropriate BMP at locations where the water table is within 1.8 meters (6 feet) of the ground surface and where the surrounding soil stratum is unstable. In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil. The BMP is also not recommended for areas with slopes greater than 20 percent, or where mature tree removal would be required. Clogging may be a problem, particularly if the BMP receives runoff with high sediment loads.

Bioretention provides storm water treatment that enhances the quality of downstream water bodies. Runoff is temporarily stored in the BMP and released over a period of four days to the receiving water. The BMP is also able to provide shade and wind breaks, absorb noise, and improve an area's landscape.

DESIGN CRITERIA

Design details have been specified by the Prince George's County DER in a document entitled *Design Manual for the Use of Bioretention in Storm Water Management* (PGDER, 1993). The specifications were developed after extensive research on soil adsorption capacities and rates, water balance, plant pollutant removal potential, plant adsorption capacities and rates, and maintenance requirements. A case study was performed using the specifications at three commercial sites and one residential site in Prince George's County, Maryland.

Each of the components of the bioretention area is designed to perform a specific function. The grass buffer strip reduces incoming runoff velocity and filters particulates from the runoff. The sand bed also reduces the velocity, filters particulates, and spreads flow over the length of the bioretention area. Aeration and drainage of the planting soil are provided by the 0.5 meter (18 inch) deep sand bed. The ponding area provides a temporary storage location for runoff prior to its evaporation or infiltration. Some particulates not filtered out by the grass filter strip or the sand bed settle within the ponding area.

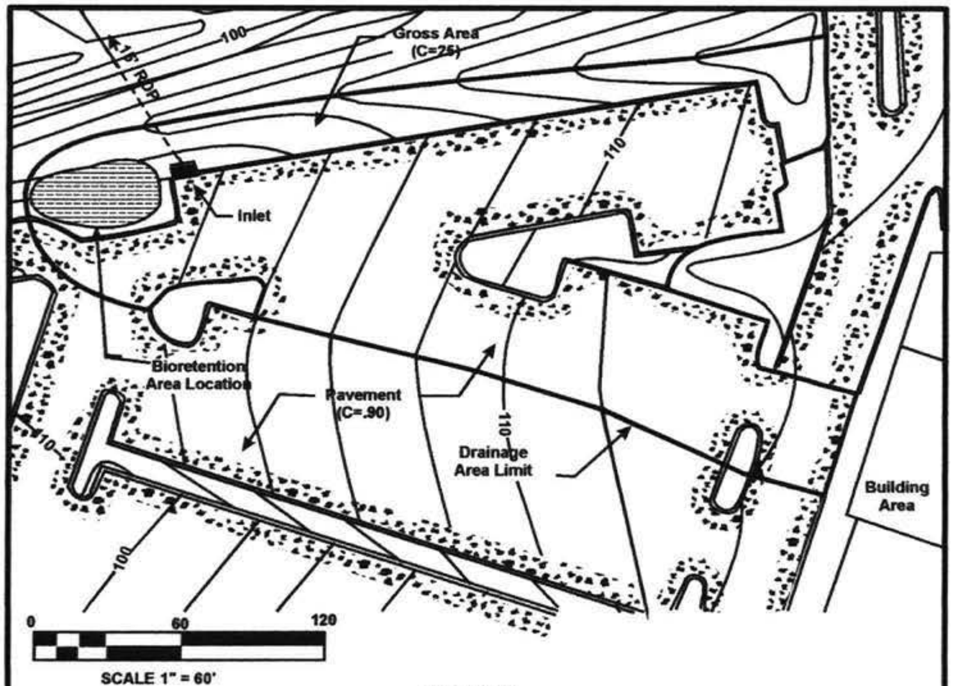
The organic or mulch layer also filters pollutants and provides an environment conducive to the growth of microorganisms, which degrade petroleum-based products and other organic material. This layer acts in a similar way to the leaf litter in a forest and prevents the erosion and drying of underlying soils. Planted ground cover reduces the potential for erosion as well, slightly more effectively than mulch. The maximum sheet flow velocity prior to erosive conditions is 0.3 meters per second (1 foot per second) for planted ground cover and 0.9 meters per second (3 feet per second) for mulch.

The clay in the planting soil provides adsorption sites for hydrocarbons, heavy metals, nutrients and other pollutants. Storm water storage is also provided by the voids in the planting soil. The stored water and nutrients in the water and soil are then available to the plants for uptake.

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered. Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil. An unstable surrounding soil stratum (e.g., Marlboro Clay) and soils with a clay content greater than 25 percent may preclude the use of bioretention, as would a site with slopes greater than 20 percent or a site with mature trees that would be removed during construction of the BMP. Bioretention can be designed to be off-line or on-line of the existing drainage system. The "first flush" of runoff is diverted to the off-line system. The first flush of runoff is the initial runoff volume that typically contains higher pollutant concentrations than those in the extended runoff period. On-line systems capture the first flush but that volume of water will likely be washed out by subsequent runoff resulting in a release of the captured pollutants. The size of the drainage area for one bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Multiple bioretention areas may be required for larger drainage areas. The maximum drainage area for one bioretention area is determined by the amount of sheet flow generated by a 10-year storm. Flows greater than 141 liters per second (5 cubic feet per second) may potentially erode stabilized areas. In Maryland, such a flow generally occurs with a 10-year storm at one-acre commercial or residential sites. The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area is a function of the drainage area and the runoff generated from the area. The size should be 5 to 7 percent of the drainage area multiplied by the rational method runoff coefficient, "c," determined for the site. The 5 percent specification applies to a bioretention area that includes a sand bed; 7 percent to an area without one. An example of sizing a facility is shown in Figure 2. For this discussion, sizing specifications are based on 1.3 to 1.8 centimeters (0.5 to 0.7 inches) of precipitation over a 6-hour period (the mean storm event for the Baltimore-Washington area), infiltrating into the bioretention area. Other areas with different mean storm events will need to account for the difference in the design of the BMP. Recommended minimum dimensions of the bioretention area are 4.6 meters (15 feet) wide by 12.2 meters (40 feet) in length. The minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established that replicates a natural forest and creates a microclimate. This enables the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 7.6 meters (25 feet), with a length of twice the width. Any facilities wider than 6.1 meters (20 feet) should be twice as long as they are wide. This length requirement promotes the distribution of flow and decreases the chances of concentrated flow.

The maximum recommended ponding depth of the bioretention area is 15 centimeters (6 inches). This



PLAN VIEW

BIORETENTION AREA
SIZING COMPUTATION

DEVELOPMENT	AREA SQ. FT.	"C" FACTOR	C X AREA
PAVEMENT	23,800	0.90	21,400
GRASS	10,100	0.25	2,500
TOTALS	33,900		23,900

BIOTENTION AREA SIZE

1. With Sand Bed (5% Sum of C x Area)
   = 05 x 23,900 = 1,195 OR SAY 1,200 sq. ft.
2. Without Sand Bed (7% Sum of C x Area)
   = 07 x 23,900 = 1,1673 OR SAY 1,700 sq. ft.

* SEE CHAPTER IV. PRINCE GEORGES COUNTYSTORMWATER MANAGEMENT MANUAL

Source: PGDER, 1993.

FIGURE 2 BIORETENTION AREA SIZING

depth provides for adequate storage and prevents water from standing for excessive periods of time. Because of some plants' water intolerance, water left to stand for longer than four days restricts the type of plants that can be used. Further, mosquitoes and other insects may start to breed if water is standing for longer than four days.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent. The soil should have infiltration rates greater than 1.25 centimeters (0.5 inches) per hour, which is typical of sandy loams, loamy sands, or loams. Silt loams and clay loams generally have rates of less than 0.68 centimeters (0.27 inches) per hour. The pH of the soil should be between 5.5 and 6.5. Within this pH range, pollutants (e.g., organic nitrogen and phosphorus) can be adsorbed by the soil and microbial activity can flourish. Other requirements for the planting soil are a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts. In addition, criteria for magnesium, phosphorus, and potassium are 39.2 kilograms per acre (35 pounds per acre), 112 kilograms per acre (100 pounds per acre), and 95.2 kilograms per acre (85 pounds per acre), respectively. Soil tests should be performed for every 382 cubic meters (500 cubic yards) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area.

Planting soil should be 10.1 centimeters (4 inches) deeper than the bottom of the largest root ball and 1.2 meters (4 feet) altogether. This depth will provide adequate soil for the plants' root systems to become established and prevent plant damage due to severe wind. A soil depth of 1.2 meters (4 feet) also provides adequate moisture capacity. To obtain the recommended depth, most sites will require excavation. Planting soil depths of greater than 1.2 meters (4 feet) may require additional construction practices (e.g., shoring measures). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. The bioretention area should be vegetated to resemble a terrestrial forest community ecosystem, which is dominated by understory trees (high canopy trees may be destroyed during maintenance) and has discrete soil zones as well as a mature canopy and a distinct sub-canopy of understory trees, a shrub layer, and herbaceous ground covers. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For example, a 4.6 meter (15 foot) by 12.2 meter (40 foot) bioretention area (55.75 square meters or 600 square feet) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1. On average, the trees should be spaced 3.65 meters (12 feet) apart and the shrubs should be spaced 2.4 meters (8 feet) apart. In the metropolitan Washington, D.C., area, trees and shrubs should be planted from mid-March through the end of June or from mid-September through mid-November. Planting periods in other areas of the U.S. will vary. Vegetation should be watered at the end of each day for fourteen days following its planting.

Native species that are tolerant to pollutant loads and varying wet and dry conditions should be used in the bioretention area. These species can be determined from several published sources, including *Native Trees, Shrubs, and Vines for Urban and Rural America* (Hightshoe, 1988). The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures (e.g., provide a soil breach) to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities.

The optimal placement of vegetation within the bioretention area should be evaluated by the designers. Plants should be placed at irregular intervals to replicate a natural forest. Shade and shelter from the wind will be provided to the bioretention area if the designer places the trees on the perimeter of the area. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. Species that are more tolerant to cold winds (e.g., evergreens) should be placed in windier areas of the site.

After the trees and shrubs are placed, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted during the spring of the year. Mulch should be placed immediately after trees and shrubs are planted. Five to 7.6 cm (2 to 3 inches) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion. Mulch depths should be kept below 7.6 centimeters (3 inches) because more would interfere with the cycling of carbon dioxide and oxygen between the soil and the atmosphere. The mulch should be aged for at least six months (one year is optimal), and applied uniformly over the site.

PERFORMANCE

Bioretention removes storm water pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization. Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Therefore, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and some hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover and planting soil. The media trap particulate matter and allow water to pass through. The filtering effectiveness of the bioretention area may decrease over time. Common particulates removed from storm water include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter (e.g., petroleum). Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately aerated.

Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

Volatilization also plays a role in pollutant removal. Pollutants such as oils and hydrocarbons can be removed from the wetland via evaporation or by aerosol formation under windy conditions. The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic storm water runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals an nutrients are shown in Table 1. As shown, the BMP removed between 93 and 98 percent of metals, between 68 and 80 percent of TKN and between 70 and 83 percent of total phosphorus. For all of the pollutants analyzed, results of the laboratory study were similar to those of field experiments. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants levels (Davis et al, 1998). For other parameters, results from the performance studies for infiltration BMPs, which are similar to bioretention, can be used to estimate bioretention's performance. These removal rates are also shown in Table 1. As shown, the BMP could potentially achieve greater than 90 percent removal rates for total suspended solids, organics, and bacteria. The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

TABLE 1 LABORATORY AND ESTIMATED BIORETENTION

Pollutant	Removal Rate
Total Phosphorus	70%-83% [1]
Metals (Cu, Zn, Pb)	93%-98% [1]
TKN	68%-80% [1]
Total Suspended Solids	90% [2]
Organics	90% [2]
Bacteria	90% [2]

Source: [1]Davis et al. (1998)
[2]PGDER (1993)

OPERATION AND MAINTENANCE

Recommended maintenance for a bioretention area includes inspection and repair or replacement of the treatment area components. Trees and shrubs should be inspected twice per year to evaluate their health and remove any dead or severely diseased vegetation. Diseased vegetation should be treated as necessary using preventative and low-toxic measures to the extent possible. Pruning and weeding may also be necessary to maintain the treatment area's appearance. Mulch replacement is recommended when erosion is evident or when the site begins to look unattractive. Spot mulching may be adequate when there are random void areas; however, once every two to three years the entire area may require mulch replacement. This should be done during the spring. The old mulch should be removed before the new mulch is distributed. Old mulch should be disposed of properly.

The application of an alkaline product, such as limestone, is recommended one to two times per year to counteract soil acidity resulting from slightly acidic precipitation and runoff. Before the limestone is applied, the soils and organic layer should be tested to determine the pH and therefore the quantity of limestone required. When levels of pollutants reach toxic levels which impair plant growth and the effectiveness of the BMP, soil replacement may be required (PGDER, 1993).

COSTS

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development. Recently-constructed 37.16 square meter (400 square foot) bioretention areas in Prince George's County, MD cost approximately $500. These units are rather small and their cost is low. The cost estimate includes the cost for excavating 0.6 to 1 meters (2 to 3 feet) and vegetating the site with 1 to 2 trees and 3 to 5 shrubs. The estimate does not include the cost for the planting soil, which increases the cost for a bioretention area. Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland (Kettering Development) with 15 bioretention areas were estimated at $111,600.

The use of bioretention can decrease the cost for storm water conveyance systems at a site. A medical office building in Maryland was able to reduce the required amount of storm drain pipe from 243.8 meters (800 feet) to 70.1 meters (230 feet) with the use of bioretention. The drainage pipe costs were reduced by $24,000, or 50 percent of the total drainage cost for the site (PGDER, 1993). Landscaping costs that would be required at a development regardless of the installation of the bioretention area should also be considered when determining the net cost of the BMP.

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

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and Designing Urban Best Management Practices. Metropolitan Washington Council of Governments.

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Stormwater Phase II Final Rule

Construction Site Runoff Control Minimum Control Measure

This fact sheet profiles the Construction Site Runoff Control minimum control measure, one of six measures that the operator of a Phase II regulated small municipal separate storm sewer system (MS4) is required to include in its stormwater management program to meet the conditions of its National Pollutant Discharge Elimination System (NPDES) permit. This fact sheet outlines the Phase II Final Rule requirements and offers some general guidance on how to satisfy them. It is important to keep in mind that the small MS4 operator has a great deal of flexibility in choosing exactly how to satisfy the minimum control measure requirements.

Why Is The Control of Construction Site Runoff Necessary?

Polluted stormwater runoff from construction sites often flows to MS4s and ultimately is discharged into local rivers and streams. Of the pollutants listed in Table 1, sediment is usually the main pollutant of concern. According to the 2000 National Water Quality Inventory, States and Tribes report that sedimentation is one of the most widespread pollutants affecting assessed rivers and streams, second only to pathogens (bacteria). Sedimentation impairs 84,503 river and stream miles (12% of the assessed river and stream miles and 31% of the impaired river and stream miles). Sources of sedimentation include agriculture, urban runoff, construction, and forestry. Sediment runoff rates from construction sites, however, are typically 10 to 20 times greater than those of agricultural lands, and 1,000 to 2,000 times greater than those of forest lands. During a short period of time, construction sites can contribute more sediment to streams than can be deposited naturally during several decades. The resulting siltation, and the contribution of other pollutants from construction sites, can cause physical, chemical, and biological harm to our nation's waters. For example, excess sediment can quickly fill rivers and lakes, requiring dredging and destroying aquatic habitats.

Table 1

Pollutants Commonly Discharged From Construction Sites
Sediment
Solid and sanitary wastes
Phosphorous (fertilizer)
Nitrogen (fertilizer)
Pesticides
Oil and grease
Concrete truck washout
Construction chemicals
Construction debris

What Is Required?

The Phase II Final Rule requires an operator of a regulated small MS4 to develop, implement, and enforce a program to reduce pollutants in stormwater runoff to their MS4 from construction activities that result in a land disturbance of greater than or equal to one acre. The small MS4 operator is required to:

- ❑ Have an ordinance or other regulatory mechanism requiring the implementation of proper erosion and sediment controls, and controls for other wastes, on applicable construction sites;
- ❑ Have procedures for site plan review of construction plans that consider potential water quality impacts;

- ❑ Have procedures for site inspection and enforcement of control measures;
- ❑ Have sanctions to ensure compliance (established in the ordinance or other regulatory mechanism);
- ❑ Establish procedures for the receipt and consideration of information submitted by the public; and
- ❑ Determine the appropriate best management practices (BMPs) and measurable goals for this minimum control measure. Suggested BMPs (i.e., the program actions/activities) and measurable goals are presented below.

What Are Some Guidelines for Developing and Implementing This Measure?

Further explanation and guidance for each component of a regulated small MS4's construction program is provided below.

Regulatory Mechanism

Through the development of an ordinance or other regulatory mechanism, the small MS4 operator must establish a construction program that controls polluted runoff from construction sites with a land disturbance of greater than or equal to one acre. Because there may be limitations on regulatory legal authority, the small MS4 operator is required to satisfy this minimum control measure only to the maximum extent practicable and allowable under State, Tribal, or local law.

Site Plan Review

The small MS4 operator must include in its construction program requirements for the implementation of appropriate BMPs on construction sites to control erosion and sediment and other waste at the site. To determine if a construction site is in compliance with such provisions, the small MS4 operator should review the site plans submitted by the construction site operator before ground is broken.

Site plan review aids in compliance and enforcement efforts since it alerts the small MS4 operator early in the process to the planned use or non-use of proper BMPs and provides a way to track new construction activities. The tracking of sites is useful not only for the small MS4 operator's recordkeeping and reporting purposes, which are required under their NPDES stormwater permit (see Fact Sheet 2.9), but also for members of the public interested in ensuring that the sites are in compliance.

Inspections and Penalties

Once construction commences, BMPs should be in place and the small MS4 operator's enforcement activities should begin. To ensure that the BMPs are properly installed, the small MS4 operator is required to develop procedures for site inspection and enforcement of control measures to deter infractions. Procedures could include steps to identify priority sites for inspection and enforcement based on the nature and extent of the construction activity, topography, and the characteristics of soils and receiving water quality. Inspections give the MS4 operator an opportunity to provide additional guidance and education, issue warnings, or assess penalties. In early 2002, EPA's Office of Compliance established a national workgroup to address issues related to the construction industry. The workgroup has developed a construction industry compliance assistance Web site as a tool for builders and developers (www.cicacenter.org). Inspectors can use the Web site to find plain language explanations of the major environmental laws affecting the construction industry as well as guidance that can be distributed developers and construction site operators.

To conserve staff resources, one possible option for small MS4 operators is to have inspections performed by the same inspector that visits the sites to check compliance with health and safety building codes.

Information Submitted by the Public

A final requirement of the small MS4 program for construction activity is the development of procedures for the receipt and consideration of public inquiries, concerns, and information submitted regarding local construction activities. This provision is intended to further reinforce the public participation component of the regulated small MS4 stormwater program (see Fact Sheet 2.4) and to recognize the crucial role that the public can play in identifying instances of noncompliance.

The small MS4 operator is required only to *consider* the information submitted, and may not need to follow-up and respond to every complaint or concern. Although some form of enforcement action or reply is not required, the small MS4 operator is required to demonstrate acknowledgment and consideration of the information submitted. A simple tracking process in which submitted public information, both written and verbal, is recorded and then given to the construction site inspector for possible follow-up will suffice.

What Are Appropriate Measurable Goals?

Measurable goals, which are required for each minimum control measure, are intended to gauge permit compliance and program effectiveness. The measurable goals, as well as the BMPs, should reflect the needs and characteristics of the operator and the area served by its small MS4. Furthermore, they should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure.

EPA has developed a Measurable Goals Guidance for Phase II MS4s that is designed to help program managers comply with the requirement to develop measurable goals. The guidance presents an approach for MS4 operators to develop measurable goals as part of their stormwater management plan. For example, an MS4 program goal might be to educate at least 80 percent of all construction site operators and contractors about proper selection, installation, inspection, and maintenance of BMPs by the end of the permit term, which will help to ensure compliance with erosion and sediment control requirements. This goal could be tracked by documenting attendance at local, State, or Federal training programs. Attendance can be encouraged by decreasing permitting fees for those contractors who have been trained and provide proof of attendance when applying for permits.

Are Construction Sites Covered Under the NPDES Stormwater Program?

Yes. On March 10, 2003, Phase II NPDES regulations came into effect that extended coverage to construction sites that disturb one to five acres in size, including smaller sites that are part of a larger common plan of development or sale (see Fact Sheet 3.0 for information on the Phase II construction program). Sites disturbing five acres or more were regulated previously. Most states have been authorized to implement the NPDES stormwater program and have issued, or are developing state-specific construction general permits. EPA remains the permitting authority in a few states, territories, and on most land in Indian Country, however. For construction (and other land disturbing activities) in areas where EPA is the permitting authority, operators must meet the requirements of the EPA Construction General Permit (CGP). Permitting authority information can be found in Appendix B of the CGP. CGP permit requirements include the submission of a Notice of Intent and the development of a stormwater pollution prevention plan (SWPPP). The SWPPP must include a site description and measures and controls to prevent or minimize pollutants in stormwater discharges.

Even though all construction sites that disturb more than one acre are covered by national NPDES regulations, the construction site runoff control minimum measure for the small MS4 program is needed to induce more localized site regulation and enforcement efforts, and to enable operators of regulated small MS4s to more effectively control construction site discharges into their MS4s.

To aid operators of regulated construction sites in their efforts to comply with both local requirements and their NPDES permit, the Phase II Final Rule includes a provision that allows the NPDES permitting authority to reference a "qualifying State, Tribal or local program" in the NPDES general permit for construction. This means that if a construction site is located in an area covered by a qualifying local program, then the construction site operator's compliance with the local program constitutes compliance with their NPDES permit. A regulated small MS4's stormwater program for construction could be a "qualifying program" if the MS4 operator requires a SWPPP, in addition to the requirements summarized in this fact sheet.

The ability to reference other programs in the NPDES permit is intended to reduce confusion between overlapping and similar local and NPDES permitting authority requirements, while still providing for both local and national regulatory coverage of the construction site. The provision allowing NPDES permitting authorities to reference other programs has no impact on, or direct relation to, the small MS4 operator's responsibilities under the construction site runoff control minimum measure profiled here.

Is a Small MS4 Required to Regulate Construction Sites that the Permitting Authority has Waived from the NPDES Construction Program?

No. If the NPDES permitting authority waives requirements for stormwater discharges associated with small construction activity (see 40 CFR § 122.26(b)(15)(i)), the small MS4 operator is not required to develop, implement, and/or enforce a program to reduce pollutant discharges from such construction sites.

For Additional Information

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http://www.epa.gov/npdes/stormwater
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Reference Documents

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- Stormwater Phase II Final Rule Fact Sheet Series
- Stormwater Phase II Final Rule (64 *FR* 68722)
- National Menu of Best Management Practices for Stormwater Phase II
- Measurable Goals Guidance for Phase II Small MS4s
- Stormwater Case Studies
- And many others
- EPA Construction General Permit and Fact Sheet www.epa.gov/npdes/stormwater/cgp
- EPA Stormwater Management for Construction Activities and Best Management Practices: Developing Pollution Prevention Plans Guidance

☞ Construction Industry Compliance Assistance Center. http://www.cicacenter.org/

United States Environmental Protection Agency
Office of Water (4203)
EPA 833-F-00-009
January 2000 (revised December 2005)
Fact Sheet 2.7

Stormwater Phase II Final Rule

Post-Construction Runoff Control Minimum Control Measure

This fact sheet profiles the Post-Construction Runoff Control minimum control measure, one of six measures that the operator of a Phase II regulated small municipal separate storm sewer system (MS4) is required to include in its stormwater management program in order to meet the conditions of its National Pollutant Discharge Elimination System (NPDES) permit. This fact sheet outlines the Phase II Final Rule requirements for post-construction runoff control and offers some general guidance on how to satisfy those requirements. It is important to keep in mind that the small MS4 operator has a great deal of flexibility in choosing exactly how to satisfy the minimum control measure requirements.

Why Is The Control of Post-Construction Runoff Necessary?

Post-construction stormwater management in areas undergoing new development or redevelopment is necessary because runoff from these areas has been shown to significantly affect receiving waterbodies. Many studies indicate that prior planning and design for the minimization of pollutants in post-construction stormwater discharges is the most cost-effective approach to stormwater quality management.

There are generally two forms of substantial impacts of post-construction runoff. The first is caused by an increase in the type and quantity of pollutants in stormwater runoff. As runoff flows over areas altered by development, it picks up harmful sediment and chemicals such as oil and grease, pesticides, heavy metals, and nutrients (e.g., nitrogen and phosphorus). These pollutants often become suspended in runoff and are carried to receiving waters, such as lakes, ponds, and streams. Once deposited, these pollutants can enter the food chain through small aquatic life, eventually entering the tissues of fish and humans. The second kind of post-construction runoff impact occurs by increasing the quantity of water delivered to the waterbody during storms. Increased impervious surfaces (e.g., parking lots, driveways, and rooftops) interrupt the natural cycle of gradual percolation of water through vegetation and soil. Instead, water is collected from surfaces such as asphalt and concrete and routed to drainage systems where large volumes of runoff quickly flow to the nearest receiving water. The effects of this process include streambank scouring and downstream flooding, which often lead to a loss of aquatic life and damage to property.

What Is Required?

The Phase II Final Rule requires an operator of a regulated small MS4 to develop, implement, and enforce a program to reduce pollutants in post-construction runoff to their MS4 from new development and redevelopment projects that result in the land disturbance of greater than or equal to 1 acre. The small MS4 operator is required to:

- ✓ ❑ Develop and implement strategies which include a combination of structural and/or non-structural best management practices (BMPs);
- ✓ ❑ Have an ordinance or other regulatory mechanism requiring the implementation of post-construction runoff controls to the extent allowable under State, Tribal or local law;

- ❑ Ensure adequate long-term operation and maintenance of controls;
- ❑ Determine the appropriate best management practices and measurable goals for this minimum control measure.

What Is Considered a "Redevelopment" Project?

The Phase II Final Rule applies to "redevelopment" projects that alter the "footprint" of an existing site or building in such a way that there is a disturbance of equal to or greater than 1 acre of land. Redevelopment projects do not include such activities as exterior remodeling. Because redevelopment projects may have site constraints not found on new development sites, the Phase II Final Rule provides flexibility for implementing post-construction controls on redevelopment sites that consider these constraints.

What Are Some Guidelines for Developing and Implementing This Measure?

This section includes some non-structural and structural BMPs that could be used to satisfy the requirements of the post-construction runoff control minimum measure. It is important to recognize that many BMPs are climate-specific, and not all BMPs are appropriate in every geographic area. Because the requirements of this measure are closely tied to the requirements of the construction site runoff control minimum measure (see Fact Sheet 2.6), EPA recommends that small MS4 operators develop and implement these two measures in tandem.

❑ Non-Structural BMPs

- **Planning Procedures**. Runoff problems can be addressed efficiently with sound planning procedures. Local master plans, comprehensive plans, and zoning ordinances can promote improved water quality in many ways, such as guiding the growth of a community away from sensitive areas to areas that can support it without compromising water quality.
- **Site-Based BMPs**. These BMPs can include buffer strip and riparian zone preservation, minimization of disturbance and imperviousness, and maximization of open space.

❑ Structural BMPs

- **Stormwater Retention/Detention BMPs.** Retention or detention BMPs control stormwater by gathering runoff in wet ponds, dry basins, or multichamber catch basins and slowly releasing it to receiving waters or drainage systems. These practices can be designed to both control stormwater volume and settle out particulates for pollutant removal.
- **Infiltration BMPs**. Infiltration BMPs are designed to facilitate the percolation of runoff through the soil to ground water, and, thereby, result in reduced stormwater runoff quantity and reduced mobilization of pollutants. Examples include infiltration basins/trenches, dry wells, and porous pavement.
- **Vegetative BMPs**. Vegetative BMPs are landscaping features that, with optimal design and good soil conditions, remove pollutants, and facilitate percolation of runoff, thereby maintaining natural site hydrology, promoting healthier habitats, and increasing aesthetic appeal. Examples include grassy swales, filter strips, artificial wetlands, and rain gardens.

What Are Appropriate Measurable Goals?

Measurable goals, which are required for each minimum control measure, are intended to gauge permit compliance and program effectiveness. The measurable goals, as well as the BMPs, should reflect needs and characteristics of the operator and the area served by its small MS4. Furthermore, the measurable goals should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure.

EPA has developed a Measurable Goals Guidance for Phase II MS4s that is designed to help program managers comply with the requirement to develop measurable goals. The guidance presents an approach for MS4 operators to develop measurable goals as part of their stormwater management plan. For example, an MS4 program goal might be to reduce by 30 percent the road surface areas directly connected to storm sewer systems (using traditional curb and gutter infrastructure) in new developments and redevelopment areas over the course of the first permit term. Using "softer" stormwater conveyance approaches, such as grassy swales, will increase infiltration and decrease the volume and velocity of runoff leaving development sites. Progress toward the goal could be measured by tracking the linear feet of curb and gutter not installed in development projects that historically would have been used.

For Additional Information

Contacts

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☞ Other EPA Web sites
- Ordinance Database
  www.epa.gov/owow/nps/ordinance
- Urban Nonpoint Source Guidance
  www.epa.gov/owow/nps/urbanmm/index.html
- Low Impact Development Web site
  www.epa.gov/owow/nps/lid

United States Environmental Protection Agency | Office of Water (4203) | EPA 833-F-00-006 January 2000 (revised December 2005) Fact Sheet 2.4

Stormwater Phase II Final Rule

Public Participation/ Involvement Minimum Control Measure

Stormwater Phase II Final Rule Fact Sheet Series

This fact sheet profiles the Public Participation/Involvement minimum control measure, one of six measures the operator of a Phase II regulated small municipal separate storm sewer system (MS4) is required to include in its stormwater management program to meet the conditions of its National Pollutant Discharge Elimination System (NPDES) permit. This fact sheet outlines the Phase II Final Rule requirements and offers some general guidance on how to satisfy them. It is important to keep in mind that the small MS4 operator has a great deal of flexibility in determining how to satisfy the minimum control measure requirements.

Why Is Public Participation and Involvement Necessary?

EPA believes that the public can provide valuable input and assistance to a regulated small MS4's municipal stormwater management program and, therefore, suggests that the public be given opportunities to play an active role in both the development and implementation of the program. An active and involved community is crucial to the success of a stormwater management program because it allows for:

- ***Broader public support*** since citizens who participate in the development and decision making process are partially responsible for the program and, therefore, may be less likely to raise legal challenges to the program and more likely to take an active role in its implementation;
- ***Shorter implementation schedules*** due to fewer obstacles in the form of public and legal challenges and increased sources in the form of citizen volunteers;
- ***A broader base of expertise*** and ***economic benefits*** since the community can be a valuable, and free, intellectual resource; and
- ***A conduit to other programs*** as citizens involved in the stormwater program development process provide important cross-connections and relationships with other community and government programs. This benefit is particularly valuable when trying to implement a stormwater program on a watershed basis, as encouraged by EPA.

What Is Required?

To satisfy this minimum control measure, the operator of a regulated small MS4 must:

- ❑ Comply with applicable State, Tribal, and local public notice requirements; and
- ❑ Determine the appropriate best management practices (BMPs) and measurable goals for this minimum control measure. Possible implementation approaches, BMPs (i.e., the program actions and activities), and measurable goals are described below.

What Are Some Guidelines for Developing and Implementing This Measure?

Operators of regulated small MS4s should include the public in developing, implementing, updating, and reviewing their stormwater management programs. The public participation program should make every effort to reach out and engage all economic and ethnic groups. EPA recognizes that there are challenges associated with public involvement. Nevertheless, EPA strongly believes that these challenges can be addressed through an aggressive and inclusive program. Challenges and example practices that can help ensure successful participation are discussed below.

Implementation Challenges

The best way to handle common notification and recruitment challenges is to know the audience and think creatively about how to gain its attention and interest. Traditional methods of soliciting public input are not always successful in generating interest, and subsequent involvement, in all sectors of the community. For example, municipalities often rely solely on advertising in local newspapers to announce public meetings and other opportunities for public involvement. Since there may be large sectors of the population who do not read the local press, the audience reached may be limited. Therefore, alternative advertising methods should be used whenever possible, including radio or television spots, postings at bus or subway stops, announcements in neighborhood newsletters, announcements at civic organization meetings, distribution of flyers, mass mailings, door-to-door visits, telephone notifications, and multilingual announcements. These efforts, of course, are tied closely to the efforts for the public education and outreach minimum control measure (see Fact Sheet 2.3).

In addition, advertising and soliciting help should be targeted at specific population sectors, including ethnic, minority, and low-income communities; academia and educational institutions; neighborhood and community groups; outdoor recreation groups; and business and industry. The goal is to involve a diverse cross-section of people who can offer a multitude of concerns, ideas, and connections during the program development process.

Possible BMPs

There are a variety of practices that could be incorporated into a public participation and involvement program, such as:

- ***Public meetings/citizen panels*** allow citizens to discuss various viewpoints and provide input concerning appropriate stormwater management policies and BMPs;
- ***Volunteer water quality monitoring*** gives citizens first-hand knowledge of the quality of local water bodies and provides a cost-effective means of collecting water quality data;
- ***Volunteer educators/speakers*** who can conduct workshops, encourage public participation, and staff special events;
- ***Storm drain stenciling*** is an important and simple activity that concerned citizens, especially students, can do;
- ***Community clean-ups*** along local waterways, beaches, and around storm drains;
- ***Citizen watch groups*** can aid local enforcement authorities in the identification of polluters; and
- ***"Adopt A Storm Drain" programs*** encourage individuals or groups to keep storm drains free of debris and to monitor what is entering local waterways through storm drains.

What Are Appropriate Measurable Goals?

Measurable goals, which are required for each minimum control measure, are intended to gauge permit compliance and program effectiveness. The measurable goals, as well as the BMPs, greatly depend on the needs and characteristics of the operator and the area served by the small MS4. Furthermore, they should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure.

EPA has developed a Measurable Goals Guidance for Phase II MS4s that is designed to help program managers comply with the requirement to develop measurable goals. The guidance presents an approach for MS4 operators to develop measurable goals as part of their stormwater management plan. For example, an MS4 could conclude as part of its Illicit Discharge Detection and Elimination program that a certain section of town has a high incidence of used motor oil dumping. The watershed has numerous automotive businesses including small repair shops, large auto dealerships, gas stations, and body shops. In addition, there are several large apartment complexes with areas that could be used as "do-it-yourself" oil change areas. The MS4 organizes a public meeting in the watershed to not only educate residents about stormwater issues and permit requirements, but also to ask for input regarding possible dumping areas and to determine if the community needs an oil recycling facility or some other way to safely dispose of used motor oil. In this way, the MS4 might better understand who the target audience is for illegal dumping control while implementing a valuable service for the watershed community.

For Additional Information

Contacts

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United States
Environmental Protection
Agency

Office of Water
(4203)

EPA 833-F-011
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Fact Sheet 2.9

EPA

Stormwater Phase II Final Rule

Permitting and Reporting: The Process and Requirements

Stormwater Phase II Final Rule Fact Sheet Series

The Stormwater Phase II Final Rule requires operators of certain small municipal separate storm sewer systems (MS4s) to obtain National Pollutant Discharge Elimination System (NPDES) permit coverage because their stormwater discharges are considered "point sources" of pollution. All point source discharges, unlike nonpoint sources such as agricultural runoff, are required under the Clean Water Act (CWA) to be covered by federally enforceable NPDES permits. Those systems already permitted under the NPDES Phase I stormwater program, even systems serving less than 100,000 people, are not required to be permitted under the Phase II stormwater program.

NPDES stormwater permits are issued by an NPDES permitting authority, which may be an NPDES-authorized State or a U.S. EPA Region in non-authorized States. Issued MS4 permit conditions must be satisfied (i.e., development and implementation of a stormwater management program) and periodic reports must be submitted on the status and effectiveness of the program.

This fact sheet explains the various permit options that are available to operators of regulated small MS4s and details the permit application and reporting requirements. Program requirements for regulated small MS4s are explained in Fact Sheets 2.0 through 2.8.

What Permitting Options Are Available to Operators of Regulated Small MS4s?

Unlike the Phase I program that primarily utilizes individual permits for medium and large MS4s, the Phase II approach allows operators of regulated small MS4s to choose from as many as three permitting options as listed below. At this time the NPDES permitting authorities have issued general permits for regulated small MS4s. Operators of regulated small MS4s in urbanized areas, whether automatically designated or designated by the permitting authority, should have submitted their permit applications within 90 days of permit issuance. Regulated small MS4 stormwater management programs should be fully developed and implemented by the end of the first permit term, which is typically a 5-year period. The NPDES permitting authority reserves the authority to determine which permitting options are available to the regulated small MS4s. Refer to specific NPDES permitting authority for more details about permitting options in particular states.

❑ General Permits

- General permits are strongly encouraged by EPA. The Phase II program has been designed specifically to accommodate a general permit approach.
- General permits prescribe one set of requirements for all applicable permittees. General permits are drafted by the NPDES permitting authority, then published for public comment before being finalized and issued.
- A Notice of Intent (NOI) serves as the application for the general permit. The permittee complies with the permit requirements by submitting an NOI to the NPDES permitting authority that describes the stormwater management plan, including best management practices (BMPs) and measurable goals. A Phase II permittee has the flexibility to develop

an individualized stormwater program that addresses the particular characteristics and needs of its system, provided the basic requirements of the general permit are satisfied.

- Permittees also can choose to share responsibilities for meeting the Phase II program requirements. Those entities choosing to do so may submit jointly with the other municipalities or governmental entities an NOI that identifies who will implement which minimum measures within the area served by the MS4.

- The permittee then follows the Phase II permit application requirements (see discussion in next question below).

Minimize Duplication of Effort

Two permitting options tailored to minimize duplication of effort can be incorporated into the general permit by the NPDES permitting authority. First, the permitting authority can recognize in the permit that another governmental entity is responsible under an NPDES permit for implementing any or all minimum measures. Responsibility for implementation of the measure(s) would rest with the other governmental entity, thereby relieving the permittee of its responsibility to implement that particular measure(s). For example, the NPDES permitting authority could recognize a county erosion and sediment control program for construction sites that was developed to comply with a Phase I permit. As long as the Phase II MS4s in the county comply with the county's construction program, they would not need to develop and implement their own construction programs because such activity would already be addressed by the county.

Second, the NPDES permitting authority can include conditions in a general permit that direct a permittee to follow the requirements of an existing qualifying local program rather than the requirements of a minimum measure. A qualifying local program is defined as a local, State or Tribal municipal stormwater program that imposes requirements that are equivalent to those of the Phase II MS4 minimum measures. The permittee remains responsible for the implementation of the minimum measure through compliance with the qualifying local program.

❑ Individual Permits

- Individual permits are required for Phase I "medium" and "large" MS4s, but not recommended by EPA for Phase II program implementation.

- The permittee can either submit an individual application for coverage by the Phase II MS4 program (see 40 CFR §122.34) or the Phase I MS4 program (see 40 CFR §122.26(d)).

- For individual coverage under Phase II, the permittee must follow Phase II permit application requirements and provide an estimate of square mileage served by the system and any additional information requested by the NPDES permitting authority. A permittee electing to apply for coverage under the Phase I program must follow the permit application requirements detailed at 40 CFR §122.26(d).

- The NPDES permitting authority may allow more than one regulated entity to jointly apply for an individual permit.

- The NPDES permitting authority could incorporate in the individual permit either of the two permitting options explained above in the *Minimize Duplication of Effort* section.

❑ Modification of a Phase I Individual Permit – A Co-Permittee Option

- The operator of a regulated small MS4 could participate as a limited co-permittee in a neighboring Phase I MS4's stormwater management program by seeking a modification of the existing Phase I individual permit. A list of Phase I medium and large MS4s can be obtained from the EPA Office of Wastewater Management (OWM) or downloaded from the OWM web site.

- The permittee must follow Phase I permit application requirements (with some exclusions).

- The permittee must comply with the applicable terms of the Phase I individual permit rather than the minimum control measures in the Phase II Final Rule.

What Does the Permit Application Require?

Operators of regulated small MS4s are required to submit in their NOI or individual permit application the following information:

❑ Best management practices (BMPs) are required for each of the six minimum control measures:

❶ Public education and outreach on stormwater impacts
❷ Public participation/involvement
❸ Illicit discharge detection and elimination
❹ Construction site stormwater runoff control
❺ Post-construction stormwater management in new development/redevelopment
❻ Pollution prevention/good housekeeping for municipal operations

(See Fact Sheets 2.3 through 2.8 for full descriptions of each measure, including examples of BMPs and measurable goals)

- ❑ Measurable goals for each minimum control measure (i.e, narrative or numeric standards used to gauge program effectiveness);
- ❑ Estimated months and years in which actions to implement each measure will be undertaken, including interim milestones and frequency; and
- ❑ The person or persons responsible for implementing or coordinating the stormwater program.

Relying on Another Entity

The Phase II permittee has the option of relying on other entities already performing one or more of the minimum control measures, provided that the existing control measure, or component thereof, is at least as stringent as the Phase II rule requirements. For example, a county already may have an illicit discharge detection and elimination program in place and may allow an operator of a regulated small MS4 within the county's jurisdiction to rely on the county program instead of formulating and implementing a new program. In such a case, the permittee would not need to implement the particular measure, but would still be ultimately responsible for its effective implementation. For this reason, EPA recommends that the permittee enter into a legally binding agreement with the other entity. If the permittee chooses to rely on another entity, they must note this in their permit application and subsequent reports. A Phase II permittee may even rely on another governmental entity regulated under the NPDES storm water program to satisfy all of the permittee's permit obligations. Should this option be chosen, the permittee must note this in its NOI, but does not need to file periodic reports.

What Does the Permit Require?

The operator of a regulated small MS4 has the flexibility to determine the BMPs and measurable goals, for each minimum control measure, that are most appropriate for the system. The chosen BMPs and measurable goals, submitted in the permit application, become the required stormwater management program; however, the NPDES permitting authority can require changes in the mix of chosen BMPs and measurable goals if all or some of them are found to be inconsistent with the provisions of the Phase II Final Rule. Likewise, the permittee can change its mix of BMPs if it determines that the program is not as effective as it could be Fact Sheets 2.3 through 2.8 further describe each of the minimum control measures, while the permit requirements for evaluation/assessment and recordkeeping activities are described in separate sections below.

Menu of BMPs

The BMPs for minimum measures 3 through 6 (as listed in the permit application requirements section, above) are not enforceable until the NPDES permitting authority provides a list, or "menu," of BMPs to assist permittees in the design and implementation of their stormwater management programs. The NPDES permitting authority was required to provide this menu as an aid for those operators that are unsure of the most appropriate and effective BMPs to use. Since the menu was intended to serve as guidance only, the operators can either select from the menu or identify other BMPs to meet the permit requirements. EPA has developed a menu of BMPs that can be accessed at EPA's Stormwater Web Site (http://www.epa.gov/npdes/stormwater).

What Standards Apply?

A Phase II small MS4 operator is required to design a program that:

- ❑ Reduces the discharge of pollutants to the "maximum extent practicable" (MEP);
- ❑ Protects water quality; and
- ❑ Satisfies the appropriate water quality requirements of the Clean Water Act.

Compliance with the technical standard of MEP requires the successful implementation of approved BMPs. The Phase II Final Rule considers narrative effluent limitations that require the implementation of BMPs and the achievement of measurable goals as the most appropriate form of effluent limitations to achieve the protection of water quality, rather than requiring that stormwater discharges meet numeric effluent limitations.

EPA issued Phase II NPDES permits consistent with its August 1, 1996, Interim Permitting Approach policy, which calls for BMPs in first-round stormwater permits and expanded or better tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards. In cases where information exists to develop more specific conditions or limitations to meet water quality standards, these conditions or limitations should be incorporated into the stormwater permit. Monitoring is not required under the Phase II Rule, but the NPDES permitting authority has the discretion to require monitoring if deemed necessary.

What Evaluation/Reporting Efforts Are Required?

Frequency of Reports

Reports must be submitted annually during the first permit term. For subsequent permit terms, reports must be submitted in years 2 and 4 only, unless the NPDES permitting authority requests more frequent reports.

Required Report Content
The reports must include the following:

- ❑ The status of compliance with permit conditions, including an assessment of the appropriateness of the selected BMPs and progress toward achieving the selected measurable goals for each minimum measure;
- ❑ Results of any information collected and analyzed, including monitoring data, if any;
- ❑ A summary of the stormwater activities planned for the next reporting cycle;
- ❑ A change in any identified best management practices or measurable goals for any minimum measure; and
- ❑ Notice of relying on another governmental entity to satisfy some of the permit obligations (if applicable).

A Change in Selected BMPs
If, upon evaluation of the program, improved controls are identified as necessary, permittees should revise their mix of BMPs to provide for a more effective program. Such a change, and an explanation of the change, must be noted in a report to the NPDES permitting authority.

What are the Recordkeeping Requirements?

Records required by the NPDES permitting authority must be kept for at least 3 years and made accessible to the public at reasonable times during regular business hours. Records need not be submitted to the NPDES permitting authority unless the permittee is requested to do so.

What Are the Deadlines for Compliance?

As stated previously, the NPDES permitting authorities have issued permits for regulated small MS4s. Operators of regulated small MS4s in urbanized areas, whether automatically designated or designated by the permitting authority, should have submitted their permit applications within 90 days of permit issuance. Regulated small MS4 stormwater management programs should be fully developed and implemented by the end of the first permit term, typically a 5-year period.

What are the Penalties for Noncompliance?

The operator of a regulated small MS4 is required to obtain an NPDES permit that is federally enforceable, thus subjecting the permittee to potential enforcement actions and penalties by the NPDES permitting authority if the MS4 operator does not fully comply with application or permit requirements. This federal enforceability also includes the right for interested parties to sue under the citizen suit provision of the CWA (section 505; 33 USC § 1365).

For Additional Information

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United States Environmental Protection Agency
Office of Water Washington, D.C.
EPA 832-F-99-027
September 1999

EPA

Storm Water Technology Fact Sheet
Vegetative Covers

DESCRIPTION

Soil erosion and sedimentation caused by vegetation removal, soil disturbances, changes to natural drainage patterns, or increases in impermeable ground cover are two of the primary problems associated with storm water runoff. One of the most effective ways to prevent erosion and sedimentation is to stabilize disturbed land through the addition of vegetation. This practice is referred to as "vegetative covering." Vegetative covers can be used to preserve existing vegetation and/or revegetate disturbed soils. They can provide both dust control and a reduction in erosion potential by increasing infiltration, trapping sediment, stabilizing the soil, and dissipating the energy of hard rain.

One method for establishing vegetative covers is planting either temporary or permanent new vegetation. Specific practices can include applying sod to a site, or temporarily or permanently seeding the site. Sod is a strip of permanent grass cover placed over a disturbed area to provide an immediate and permanent turf that both stabilizes the soil surface and eliminates sediment loss. Temporary seeding consists of planting grass seed immediately after rough grading to provide soil protection until a final cover is established. Permanent seeding establishes perennial vegetation in disturbed areas.

A second method for enhancing vegetative covering is by preserving existing vegetation. This allows a site's natural vegetation (existing trees, vines, bushes, and grasses) to function as a natural buffer zone during land disturbance activities.

APPLICABILITY

Vegetative covers can be applied at any site and are not restricted by the size of the site or local land uses. The type of soil, topography, and climate at the site determine the appropriate tree, shrub, and ground cover species for that particular management practice. Local climatic conditions help determine the appropriate time of year for planting. Temporary seeding is most suitable in areas disturbed by construction where the ground is left exposed for several weeks or more. Permanent seeding and planting is appropriate for any graded or cleared area where long-lived plant cover is desired. Some areas where permanent seeding is especially important are filter strips, buffer areas, vegetated swales, steep slopes, and stream banks.

ADVANTAGES AND DISADVANTAGES

Vegetative covering can be a relatively low-cost and low-maintenance practice for controlling dust and preventing erosion. It also adds to the aesthetics of a storm water control area.

Limitations of vegetative covers as a management practice include:

- Vegetative covering must be coordinated with climatic conditions for proper establishment. For example, cold climate areas have limited growing seasons and arid regions require careful selection of plant species.

- An appropriate maintenance program must be implemented to ensure the optimum performance.

DESIGN CRITERIA

Table 1 summarizes the design criteria for vegetative covers.

PERFORMANCE

Qualitatively, vegetative covers are clearly effective in controlling dust and erosion when properly implemented. The amount of runoff generated from vegetated areas is considerably reduced and of better quality than runoff from unvegetated areas. However, based on data currently available, it is not possible to quantify the water quality benefits of vegetative coverings as a BMP.

OPERATION AND MAINTENANCE

Several measures must be taken after seeding and sodding an area to promote successful growth. It is especially important to check and monitor an area after a rain event to ensure that the seeds and sod have not been damaged. If damage has occurred, the cause of damage must be assessed before repeating seed bed preparation and seeding procedures. Once a vegetative cover has been established, it is important to attend to the following:

- Watering the sod frequently and uniformly.
- Maintaining appropriate grass height for the species selected and the intended use.
- Performing occasional soil tests to determine if the soil is being appropriately fertilized.
- Controlling weeds.
- Spot seeding small and damaged areas.

COSTS

The general base capital costs for constructing a vegetative cover average around $13,800/acre for seeding and $29,000/acre for sodding. A more detailed summary of the cost estimates for sodding and seeding is provided in Table 2. Please note that costs vary depending on regional climates and soil conditions.

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